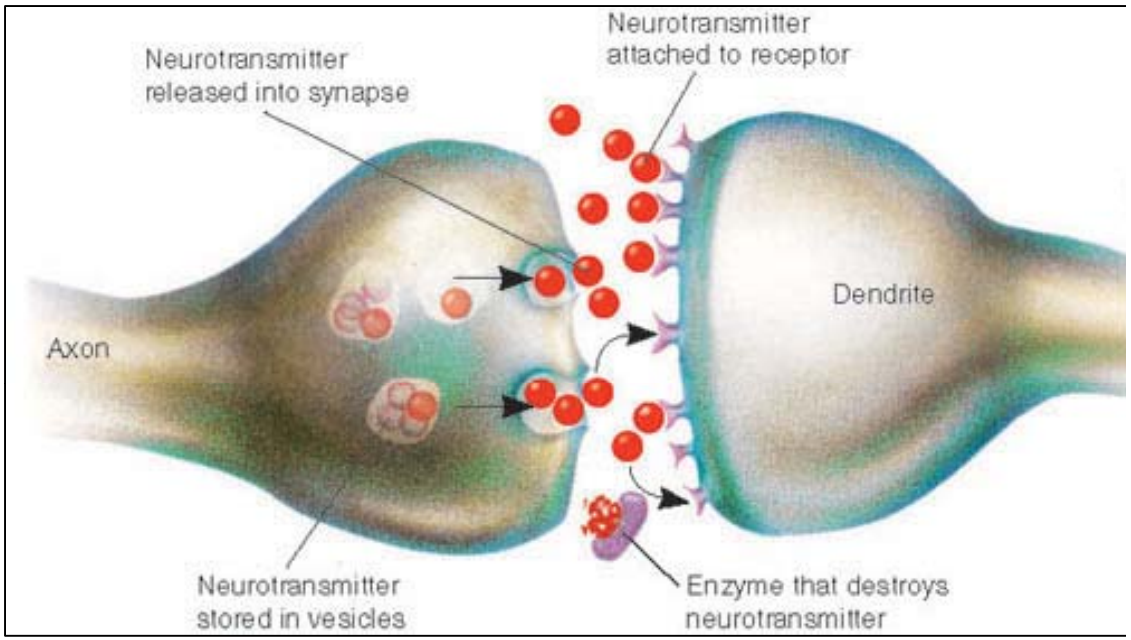
# 1. Reading assignments

## Article#1

# Vasopressin

(brain hormone)

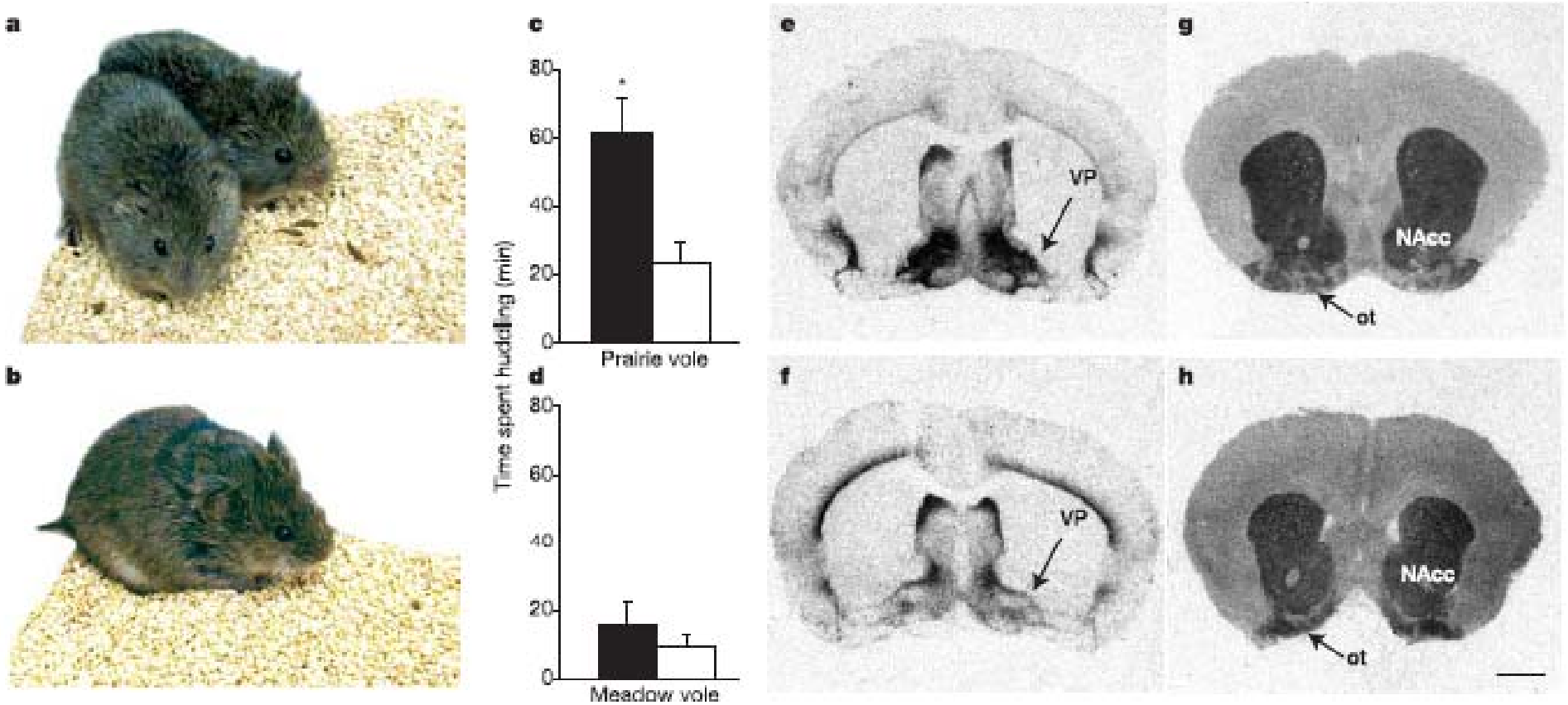
--social behavior/
pair-bonding




Vasopressin receptor (V1aR) located
in the brains.

# Vasopressin and pair-bonding

Prairie voles (monogamous) have higher **V1aR** gene expression than meadow voles (polygamous) in the ventral forebrain(both voles have the same gene)



# Quiz:

1. Prairie voles have _____than meadow voles (polygynous) in the forebrain.
   (1) More V1aR receptors
   Or ….
   (2) More vasopressin hormones

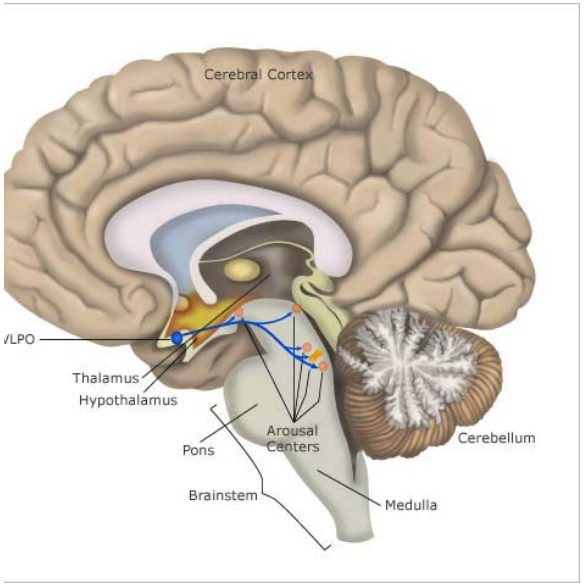
2. Design experiments to test V1aR expression is critical for pair-bonding?

   a. Inhibit V1aR expression: infuse V1aR antagonist
      → inhibit pair bond formation
   b. increase V1aR expression in v. forebrain
      → increase pair-bonding

# Article #2 **The Pregnant Brain as a Revving Race Car**

1. Mother has to have a brain that is highly sensitive to child's need.

2. Major brain changes in (a) mPOA: get ready to respond to child's need




-- quickly respond to the child.

(b) hippocampus: increase dendrite density; enhance learning/ memory

-- evolutionary advantage: locate food faster

(c) hormonal changes: more sensitive to emotional changes; facial expression
-- more focus on their child.

(d) gazing: correlates with oxytocin

# Article #4:
# Social dominance hierarchy and its costs (stress)

# It is not easy to be the dominant one…

Highly stressful, particularly if

1. Hierarchy is not stable, frequently challenged by others.
2. Dominance through fight, intimidation.
3. Resource inequity (more intense competition for resource)
4. Breeding cycles.

It is not easy to be the subordinate…

Highly stressful if…

1. In a stable hierarchy
2. In male-dominant social hierarchy
3. Less resource inequity

Article #5  Animal thinking

Criterion of conscious awareness in animals is versatile adaptability of behavior to changing circumstances and challenges.

- particularly, when an animal behaves in a novel and surprising situation that requires specific actions not called for under ordinary circumstances.

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Japanese macaques learn new skills
wash potatoes → wash rice

Conscious thinking: versatile adaptability of behavior to changing circumstances

# Article #6: Alex the parrot

1. What's the advantage of using parrots than other animals to study animal cognition?

2. What is Irene's methods to train the parrots? Rival-model → purpose?

# Article #7: Great tit's personality

1. Why hasn't one personality become the standard in the population? Why do animal evolve different personalities?

    1. Depending on ecological situation (food availability)
    2. Depending on what other birds do:
        game theory: hawk/dove game
    3. Intermediate personality seems to be better

2. What are the experiments in this article to test and measure the personality of the great tit?

PROCEEDINGS OF THE ROYAL SOCIETY B

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# *Drd4* gene polymorphisms are associated with personality variation in a passerine bird

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Personality
Vs.
DRD4

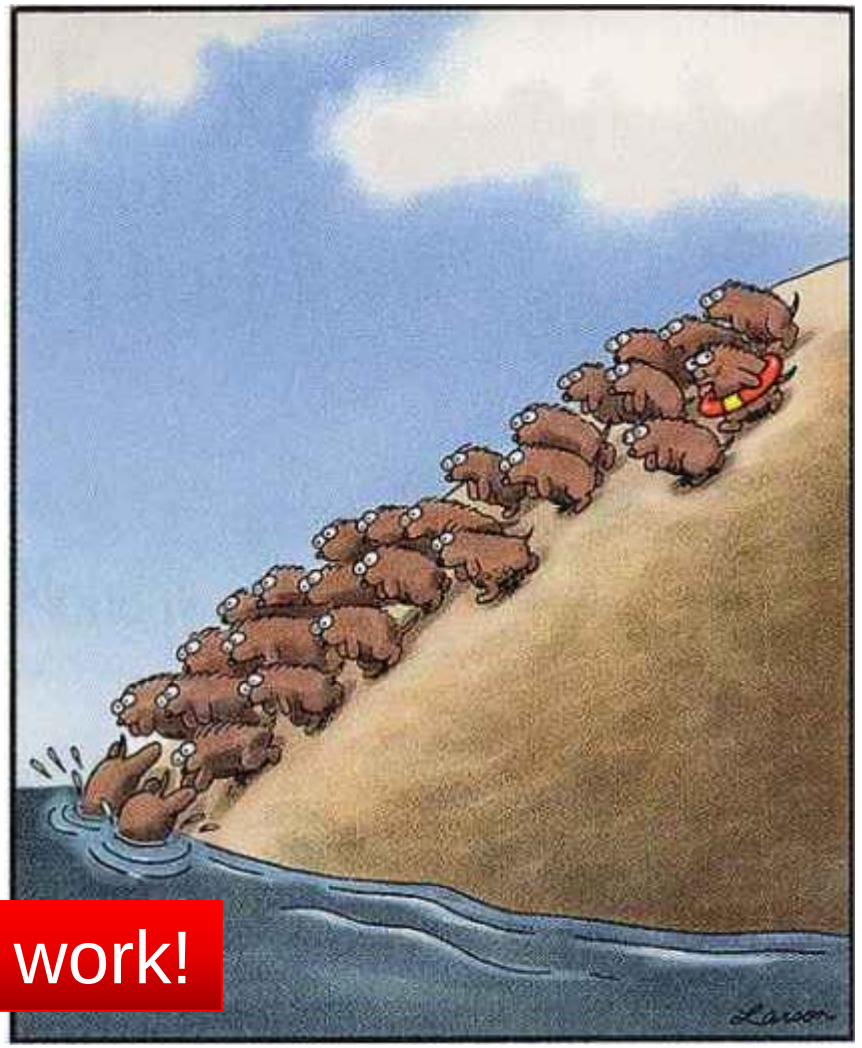
# 2. Lecture notes

Natural selection is selecting

1. Gene
2. Individual
3. Group

# Cheaters will have reproductive success, and their “cheating” genes will prevail!

Lemmings (rodents)



Group selection doesn’t work!


# The gene as the unit of selection?

# Parental care

## Female cost vs. benefit:

Females have already invested so much in producing eggs + physiological constraints.

Females are sure of their genes will pass on, if the eggs are fertilized internally.

Depending on offspring survival if without care

## Male cost vs. benefit:

Males tend to mate as many mates as possible, invest more energy on attracting females

Males are not sure if their genes will pass on.

Depending on offspring survival

Male fishes are unusual that they often provide uni-parental care:

1. external fertilization
2. defend territory
3. ensure paternity

Randall's Jawfish

Stickleback

# Parent-offspring recognition

# 3. Parent-offspring recognition

**Many colonial species  recognize offspring**

# Bank swallows and rough-winged swallows are closely related

Bank swallows: colonial species, fledglings have distinctive begging calls

Rough-winged swallows: solitary species: fledglings have, less distinctive begging calls

What species can recognize their young?

# Parent-offspring conflicts

# Why infanticide?

## 1.Sexual selection hypothesis,

infanticidal males will gain a reproductive advantage provided that only unrelated infants are killed and that the males increase their chances of siring the next infants.

## 2. Social pathology hypothesis,

infanticide as a result of crowded living conditions and not providing any advantage, regardless of relatedness.

How to test these two hypotheses?

-- test the relatedness of the killed young

# Infanticide in lions/ monkeys

killed by males

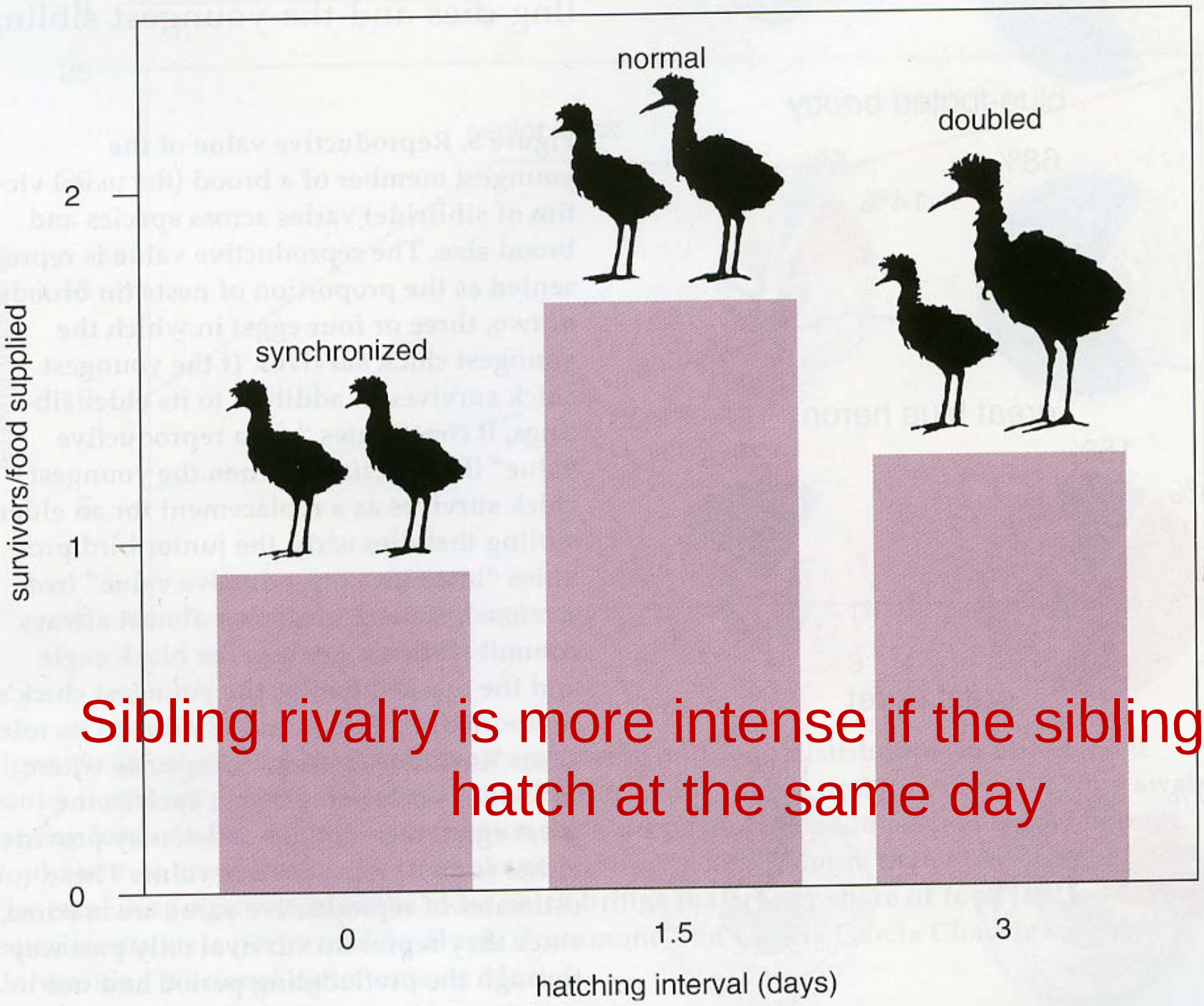
Support the “sexual selection” hypothesis

# Why sibling rivalry? (Siblicide)

Limited food provided from parents

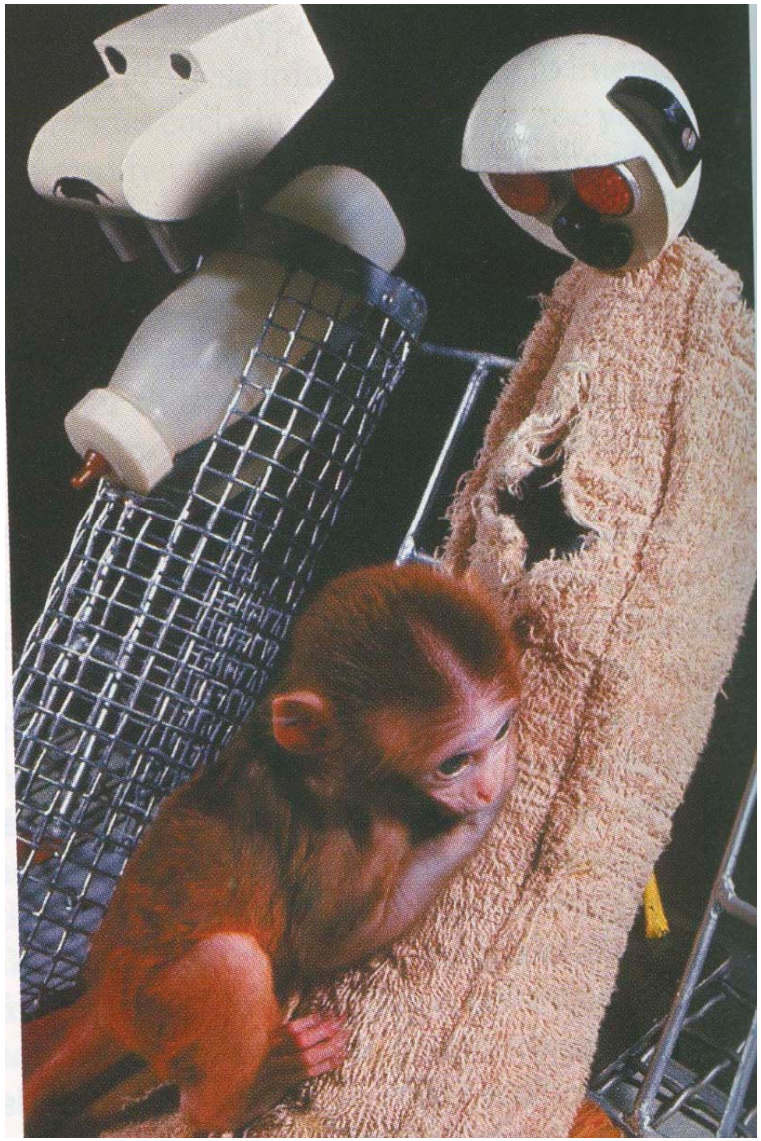
-Compete for food

-Compete for parent's feeding

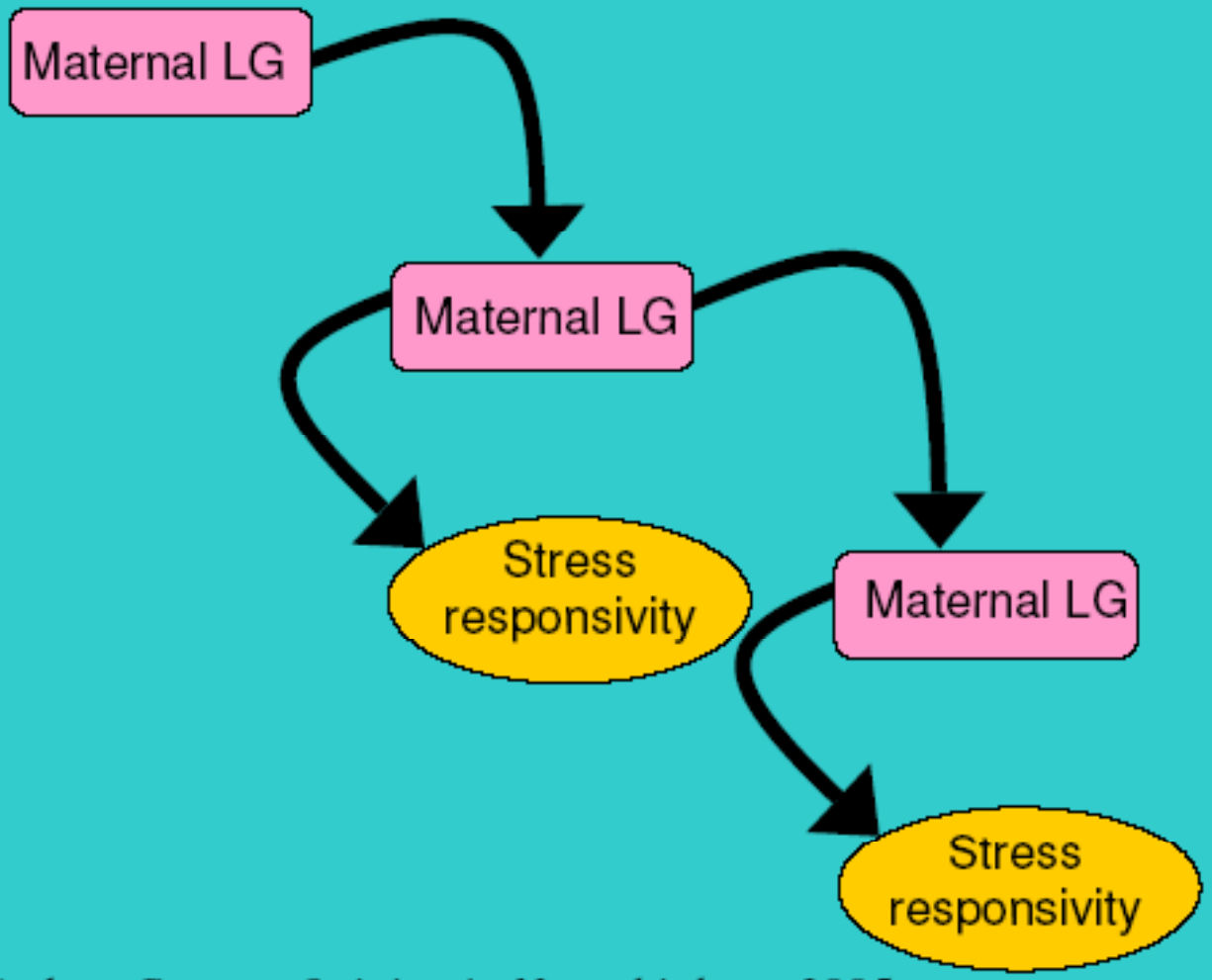



Sibling rivalry is more intense if the siblings hatch at the same day

# what can parents provide?

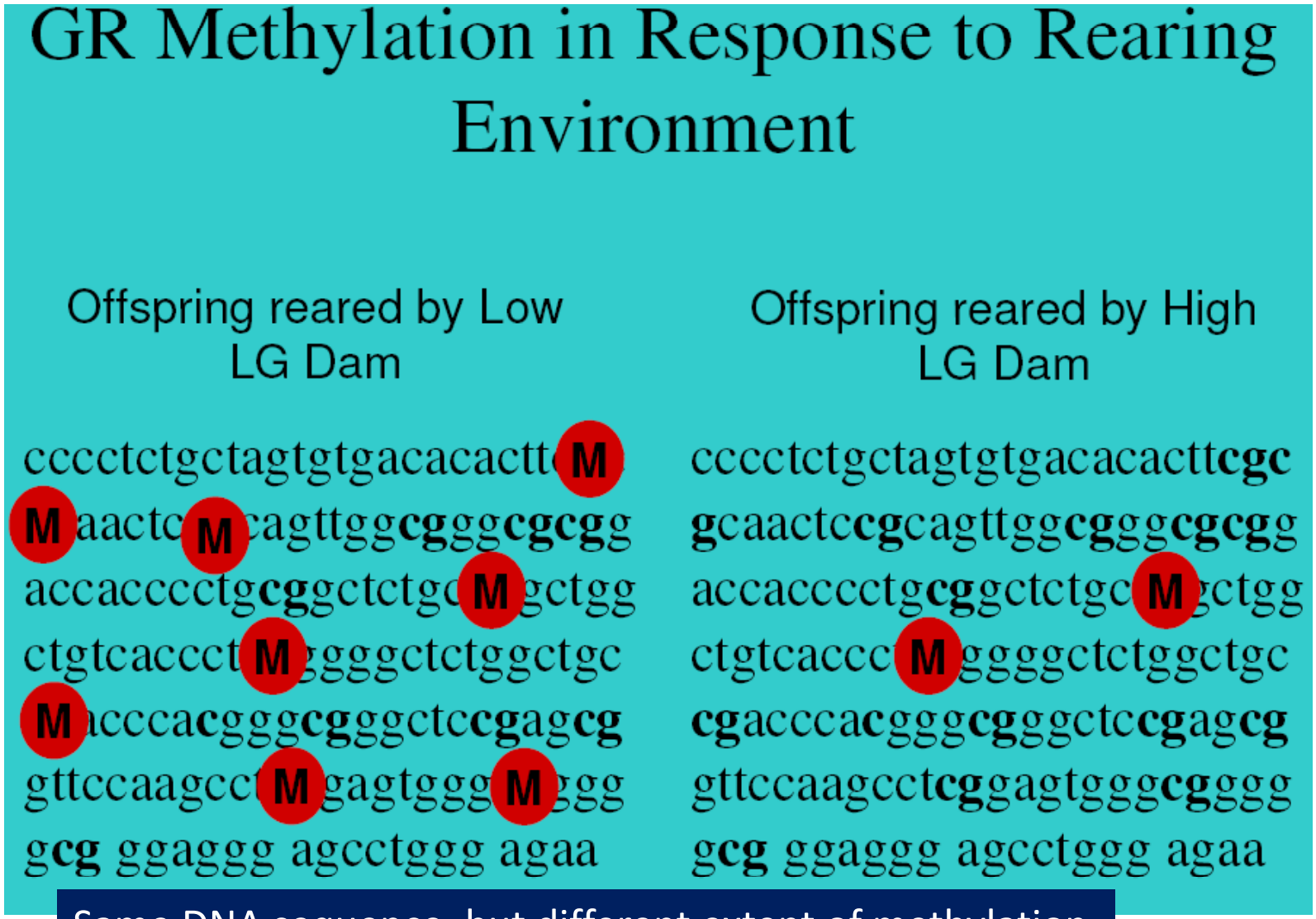


# Transmission of maternal care and stress responsivity across generations




Champagne & Curley, *Current Opinion in Neurobiology*, 2005

# Epigenetic modification of DNA




Same DNA sequence, but different extent of methylation → different expression of GR → different fear responses


Licking, hugging, kissing, gazing
induce epigenetic changes
of your child (also the mom)

# Evolution of social behavior

# Types of social interactions

1. Mutualism (cooperation)
2. Reciprocal altruism
3. Altruism
4. Selfish behavior
5. Spiteful behavior

# Benefit or cost?

| Outcome | Actor | Recipient |
|---|---|---|
| Mutualism | + | + |
| Reciprocity | + (delay) | + |
| Altruism | - (direct) | + |
| Selfish | + | - |
| Spiteful | - | - |

# Game theory- hawk/ dove game

Player 1 (animal 1)

Player 2 (animal 2)

| | Hawk | Dove |
|---|---|---|
| Hawk | $(v - c)/2$ | $v$ |
| Dove | 0 | $v / 2$ |

Decision making is based on the benefits and costs of the action and its consequence

# Reciprocity-prisoners' dilemma

| | | Player B | |
|---|---|---|---|
| | | Cooperate | Defect |
| Player A | Cooperate | Reward for mutual cooperation | Maximum punishment |
| | Defect | Maximum reward | Punishment for Mutual defection |

# Tit for tat strategy (reciprocity)

Three fundamental characteristics

(1) Nice: never cheats first

(2) Retaliatory: always responds to a partner that is cheating.

(3) Forgiving: only remembers one move back in time.

Examples in animals?

# Prisoner's dilemma and Tit for tat strategy

- In a one-time game, you should defect because the average payoff is greater.
- If the game is to be repeated many times, it is in both player's long-term interest to cooperate.
- Tit-for-tat is an evolutionarily stable strategy, or solution, to a repeated Prisoner's Dilemma game. The rule is: cooperate on the first play and then do what your opponent did in the last play.

# Tit for tat strategy example #2


Female bats regurgitate blood meals to others that failed to obtain food

How can altruism ever evolve?

1. Group selection (controversial)?

2. Indirect selection (Kin selection)
   (W. D. Hamilton: kinship theory)

# Halmilton's kinship theory - inclusive fitness -

* **Inclusive fitness**: an individual's total fitness is based on the number of its own offspring and the contribution it makes to the reproductive success of its genetic relatives.

* include both direct fitness (your own offspring) and indirect fitness (your sib's offspring, your grandchildren).

# How to calculate relatedness?

Two siblings are related to one another by **r=0.5**

**Sibling #1** has gene A, 50% (0-100%) chance she received gene A from her mom.

**Sibling #2** has gene A, 50% (0-100%) chance she received gene A from her mom.

There is 25% chance (50%x50%) that the siblings share gene A through their mother.

There is 25% chance that the siblings share gene A through their father.

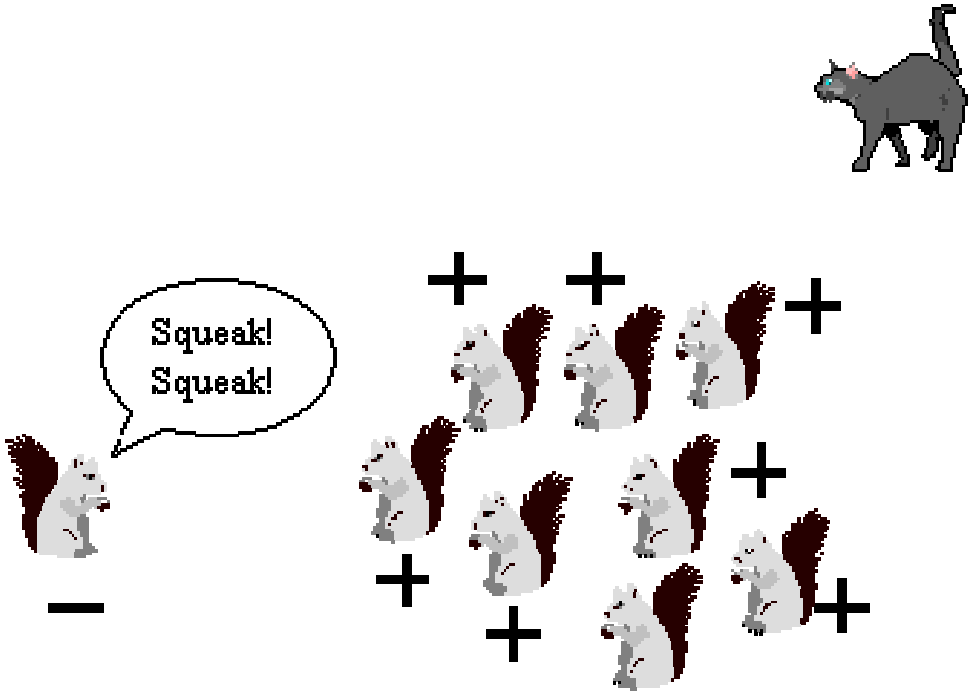
The chance that the siblings share gene A through either their mother or father: 25% + 25% =50%

# Hamilton's rule:

$$c < rb$$

c = cost of the helper
b = benefit to the recipient
r = relatedness between helper and recipient

**Giving the warning call and accounting for kin selection where the cost of giving the call is .3 and the benefit .1 to each of the others and the actor is the sister of the others (r = .5)**




c = .3

b = .1 x 8 = .8

r = .5

rb = .5 x .8 = .4

**Give the warning call because c<rb (.3 < .4)**

# What is eusocial behavior?

A form of social organization characterized by:

1. Adults live in a group.
2. Cooperative care of juveniles
3. Labor division
4. Overlap in generations

# How did Eusociality evolve? --increase inclusive fitness

1. Kin selection by haplodiploid, r ↑
2. Kin selection by inbreeding, r ↑
3. Ecological (resource) constrains
4. Multi-level selection (including group selection)

## In bees, ants and wasps (haploidiploid species)

Males come from unfertilized eggs – haploid (one set of chromosomes) ; sperms of each male are identical

Females come from fertilized eggs – diploid (two set of chromosomes) - eggs of each female are 50% identical

A female mates with a male: all her diploid daughter will carry the same set of paternal genes, but carry 50% of maternal genes

Therefore, **haploidiploid sisters** will share 75% of genes

Helping sisters indeed increase indirect fitness

# Sisters help sisters

| | Mother | Sister | Daughter | Father | Brother | Son |
|---|---|---|---|---|---|---|
| Haplodiploid | | | | | | |
| female | 0.5 | 0.75 | 0.5 | 0.5 | 0.25 | 0.5 |
| male | 1 | 0.5 | 1 | 0 | 0.5 | 0.25 |
| Diploid | | | | | | |
| female | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 |
| male | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 |

haploidiploid sisters share 75% of genes
diploid sisters share 50% of genes

# Naked mole-rats: eusocial mammals

1. Diploid animals

2. One queen with a few kings in a colony (70-80 individuals per colony)

3. Other females as sterile, altruistic workers (labor division); cooperative care of juveniles

4. A lot of inbreeding (therefore siblings are more close related than their own offspring)

5. Why this species evolves eusocial behavior?

# Human behavior/ culture shaped by natural selection

Example #1: Blood donation
Example #2: Adoption
Example #3: Mate choice
Example #4: Religion (belief in supernatural)

# Final exam question:

1. Is Blood-donation evolutionary adaptive?

# Blood-donation

Evolutionary adaptive?

-reciprocity: benefit donors and recipients

-Altruistic behavior? Benefit recipients (strangers) cost donors (assume group selection works)

Cultural influence?

- benefit may not require

# Evolution hypothesis of blood donation:

Blood donor is repaid by the donor's everyday's companions- Reciprocity

# Final exam question:

# 2. Adoption


Is adoption simply a culture phenomenon, or it has its evolutionary roots?

# Evolutionary adaptation for adoption is supported by

1. Inclusive fitness: kin-selection

2. Direct benefit:  helper

3. Mal-adaptive proximate mechanism

# Mal-adaptive hypothesis

animal examples?

# Evolutionary models of mate choice -enhance offspring fitness

- 1. Good gene hypothesis

  traits that signal good gene,

  - Symmetry, MHC, Healthy, Fertility
- 2. Direct benefit hypothesis

  - Wealthy, abundant resources…

3. Runaway hypothesis
4. Sensory exploitation hypothesis

# Bridewealth and dowry

Arbitrary cultural traditions (anthropological perspective)
bridewealth and dowry should be equally represented among cultures worldwide.

Evolutionary theory of sexual selection predicts
Males tend to compete for females
Females tend to choose males
bridewealth should be more common than dowry

66 % of 1267 societies : bridewealth payment
3% of 1267 societies: dowry payment

# Bridewealth and dowry

Arbitrary cultural traditions (anthropological perspective)
bridewealth should be equally represented
between monogamous and polygynous cultures.

Evolutionary theory of sexual selection predicts
Males tend to compete for females
Females tend to choose males
bridewealth should be more common in polygyny culture

As predicted by sexual selection,
Polygyny cultures provide more bridewealth payment

| Mating system | Bridewealth payment | Sons favored |
|---|---|---|
| Monogamy<br>N=112 cultures | 38% | 58% |
| Limited polygyny<br>(<20% of men: polygyny)<br>N=290 cultures | 54% | 80% |
| General polygyny<br>(>20% of men polygyny)<br>N=448 cultures | 91% | 97% |

# Religion:

Is it evolutionary adaptive?

Or is it acquired by culture?

Humans are born with a tendency to form supernatural beliefs ?
or acquire this ability through cultural exposure?

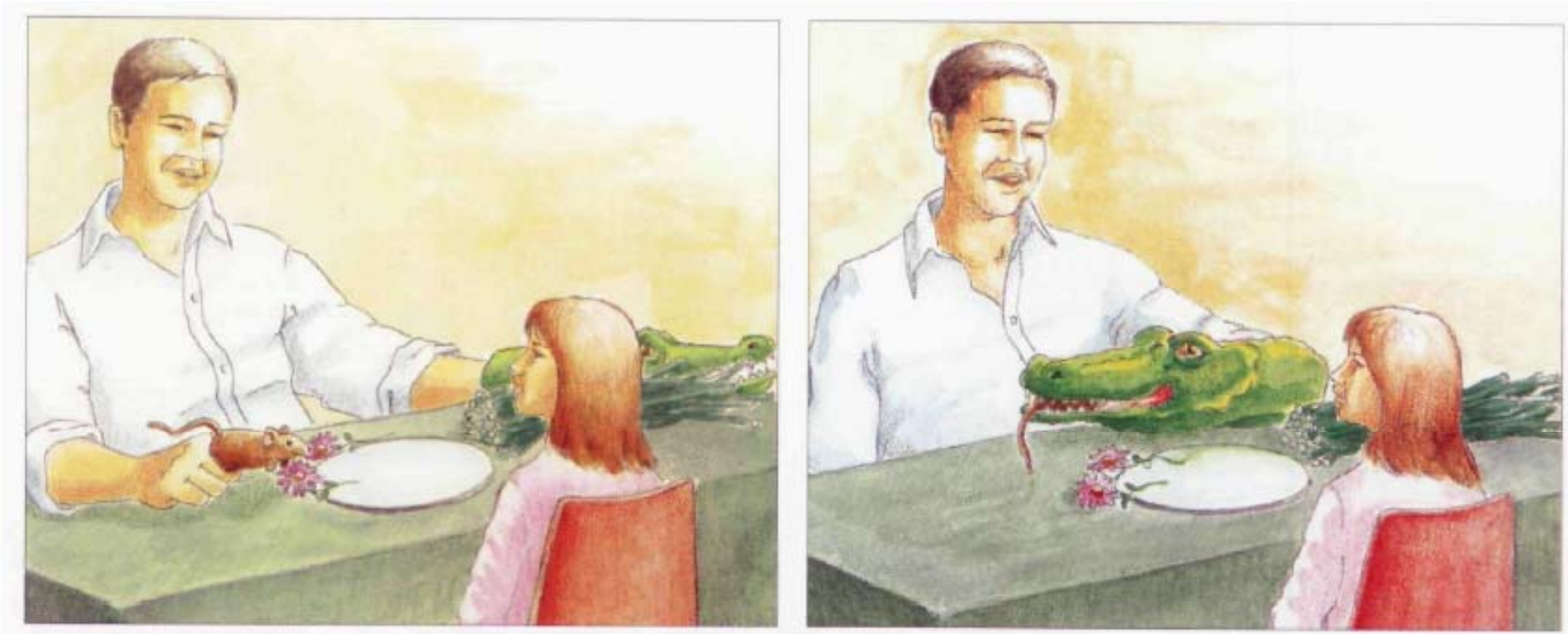


Figure 3. In a study designed to determine whether human beings are born with a tendency to form supernatural beliefs or acquire this ability through cultural exposure, children of various ages were told a story in a puppet show wherein a young mouse is suddenly eaten by an alligator. The children were then asked to describe the mouse's ability to feel or know things after its death *(see Figure 4 for results).*